REPORT ON THE DISCUSSIONS OF THE FNAL MAGNET ACCEPTANCE BOARD W/RESPECT TO LQXB01

The Fermilab magnet acceptance board met on 13 January, 2003, to review and discuss the magnet assembly LQXB01 with respect to the acceptance criteria. A summary of the comparison between the results and the criteria are presented in the summary table.
The magnet acceptance board concludes the magnet is ready to ship, and should be installed in either IR 2 or IR 8 in the LHC. The magnet acceptance board also suggests several criteria should be reviewed for their necessity.

LQXB01 (MQXB01, MQXB02) ACCEPTANCE CRITERIA SUMMARY

criteria	description	status	resp. party	reported by
2.1.1	MQXB MECHANICAL TWIST AND STRAIGHTNESS	accept; see discussion	rb	rb
2.1.2	MQXB COIL RINGING	pass	rb/sf	rb
2.1.3	THERMOMETER AND WARM UP HEATER INSTALLATION	done	rb	rb
2.1.4	BUS WORK CHECKOUT	done	rb	
2.1.5	ROOM TEMPERATURE HIPOT	accept; see discussion	rb/ml	ml
2.1.6	ROOM TEMPERATURE ELECTRICAL CHECKOUT	pass	rb/ml	ml
2.1.7	PRESSURE TEST DOCUMENTATION	done	tn/tp	tp
2.1.8	LEAK CHECK DOCUMENTATION	done	tn/tp	tp
2.1.9	CRYOSTAT SAFETY DOCUMENTATION	done	tn/tp	tp
2.1.10	PIPE ASSEMBLY DOCUMENTATION	accept; see discussionxxx	tn/tp	xxxx
2.1.11	WARM CRYOSTAT TO MAGNETIC AXIS REFERENCE	done	ps	ps
2.2.1	COLD INSTRUMENTATION CHECK OUT	pass	ml	ml
2.2.2	COLD HEATER CHECKOUT	accept; see discussion	ml	ml
2.2.3	COLD ELECTRICAL HIPOT	accept; see discussion	ml	ml
2.2.4	NO QUENCHING UP TO AND INCLUDING OPERATING GRADIENT (AFTER TRAINING)	pass	ps	ps
2.2.5	NO TRAINING DEGRADATION AFTER FULL ENERGY DEPOSITION TRIP	pass	ps	ps
2.2.6	TRANSFER FUNCTION	pass	ps	ps
2.2.7	INTEGRATED COLD HARMONICS	pass; see note	ps	ps
2.2.8	COLD ALIGNMENT	accept; see discussion	ps	ps

DISCUSSION ON THE MQXB MECHANICAL TWIST AND STRAIGHTNESS

The straightness of MQXB01 was 150µm, 25µm above allowable over the length (5.8m) of the magnet, where the least count is also 25µm. Given the measurements to be done on the beam tube location in later magnets of the series, and the apparent insensitivity of the machince aperture to this result, the tolerance should be revisited.

DISCUSSION ON HEATER CIRCUIT "B" ON Q2B:

(Section 2.1.5): Heater circuit "b" on Q2b (YT1142) has a ~30 Mohm short to the coil. This short was detected after a coil to (ground+heater) hipot failure at room temperature. With this heater circuit floating, the hipot test was successfully completed. This high resistance short has remained throughout the testing and post cold test electrical checkout.

(Section 2.2.2): Because of the high resistance short to ground, Q2b circuit "b" heater (YT1142) was not tested cold. The other three circuits were extensively tested and shown to be effective.

(Section 2.2.3): The high resistance to ground heater (YT1142) is floated during these tests. The three operating heater circuits were successfully hipoted from heater to (ground + coil) to the required 1400 V. However for the coil to ground + heater test, the maximum voltage achieved was 1100 V. (100 V less than the required 1200V)

This cold hipot must be accomplished using the test stand instrumentation and bus feed throughs. We had several hipot problems with our test stand, problems we finally isolated and fixed but only after several months of investigation and only after a feed can-to-end can (zero magnet) cold test. By this time LQXB01 was removed from the test stand. In fairness we note that we do not fully understand the relationship between the breakdown level and location observed on the zero magnet test stand tests and that observed on the magnet + test stand tests. However, the wiring and grounding for this test stand is quite complicated, with instrumentation wires and shielding ground lines fanned out to several connectors.

Despite these test stand problems, the magnet passed other hipot tests which give us confidence in its hipot integrity. For example, it passed the 5kV in air hipot as show in 2.2.2. above. It also passed a 4 atmosphere warm helium hipot test to >1400 V, which from the literature is more stringent than a 1 atmosphere cold helium test. After the magnet was removed from the tests stand, in room temperature N2, there was a final hipot test of heaters to (ground + coils) to 1500 V and coils to (ground + heaters) to 1500 V with low leakage current and no breakovers.

Note that for checkout at CERN heater YT1142 has been disconnected from the Hypertronics pins assigned to it such that it can not be inadvertently used during machine operation.

DISCUSSION ON SURVEYED PIPE LOCATIONS:

Several of the pipe locations are out of tolerance by xx mm (final survey has not been done as yet, we will include a table here). Given that the inner triplet interconnects have an extension piece of on order 1m between the magnet flanges, and the nominal failure mode is that of bellows instability or inability to make the connection of components inside the pipe, the increase length between connections gives greater latitude for misalignment than might be acceptable elsewhere in the machine. All bellows are restrained during operation, further limiting the potential for squirm. For this reason, the committee recommends the tolerances be re-visited.

DISCUSSION ON COLD ALIGNMENT:

The appended note from M. Xiao and T. Sen documents the affect on machine dynamic aperture using the actual offsets from the measured cold alignment of LQXB01. The results show the misalignment does not affect the machine dynamic aperture.

LQXB01 was the first of it's kind, ever made. As more data is generated as later assemblies in the series are made, the acceptance criteria for cold alignment should be re-visited.

OTHER:

LQXB01 includes corrector MCBXT001, a prototype MCBX from CERN which has 2/3 of the magnetic length of a production MCBX (LHC-MCBX-EC-0001). When this change was accepted, it was noted the assembly would be used in IR2 or IR8 only.

The ID card for LQXB01 has been completed and is being transmitted separately.